Bill Nye the Science Guy

Earthquakes

Table of Contents

1. **Implementation Guide** 2–9

   This descriptive guide will assist you in integrating the DVD science and education content into your instructional program.

2. **National Science Education Standards** 10-11

   See the complete *National Science Education Standards (NSES)* correlated for this program.

3. **Episode Guide** 12

   Step-by-step procedures make it easy to complete the experiments shown in the program. "More Interesting Stuff to Do" gives more experiments that extend student learning.

4. **Lesson Planning Worksheet** 13–14

   This template helps you incorporate all the features of the Bill Nye DVD into your daily lesson plans.

5. **Student "Know / New" Chart** 15

   A "Know-New" T-Chart assesses students' prior knowledge and what they learned.

6. **Student Recording Sheet** 16

   This handout gives you a standardized format that students can fill out as they conduct an experiment.

7. **Glossary** 17-18

   Use the terms and definitions found here to assist you in direct vocabulary instruction. The glossary terms are also found on the DVD.

8. **Quiz** 19

   This written version of the interactive quiz on the DVD provides a ready-to-go written test. Multiple choice and true-false items address key concepts found in the standards and in the program.

9. **Quiz Answer Key** 20

   A separate page contains the quiz answer key.

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Implementation Guide

Welcome to Disney's Bill Nye DVD collection! With the help of this Guide you can bring instructional DVDs into your science curriculum.

What's on the DVD?

Bill Nye DVDs expand the educational features of *Bill Nye the Science Guy* programs. Each DVD provides students with science content through video clips aligned with *National Science Education Standards (NSES)* and a host of other resources.

Short video clips aligned with the NSES provide a unique opportunity for you to enhance your lessons using DVD technology. Now you can show a video clip, or even short segments of a clip, on command. But there are a host of other features, too! See the chart below for a summary.

From the Main menu, there are three chief sections:

Feature	Description
Watch Program Menu	From this menu, you can play the program straight through or use the clips to customize your viewing.
Teacher Support	From this menu, you can access this Teacher's Guide, the Glossary, Internet Links, and the Quiz.
Bonus Materials	Use this menu to try a different discussion starter, download a special screen-saver, or check out never-before-seen footage.

From the Watch Program menu, you can:

Feature	Description
Play Program	Play the entire program from start to finish.
Bilingual Mode	View the entire program or clips in English or Spanish.
Glossary Mode	Make links to Glossary terms appear during the program.
Program Overview	View the program introduction, in which Bill discusses the topic covered.
Try This	Show students demonstrating science concepts.
Way Cool Scientist	Meet a real scientist who talks about his or her area of study.
Bill's Demonstration	Look at a science demonstration conducted by Bill Nye.
Music Video	Enjoy a short music video that summarizes the topic in an age-appropriate and entertaining manner.
Science Standards	Take advantage of short video clips from the program, which are aligned with National Science Education Standards.

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From the Teacher Support menu, you can:

Feature	Description
Science Quiz	Give students a quiz to take independently or as a class. Seven to ten quiz items are aligned with the National Science Education Standards. The items are in multiple-choice or true-false format. Each wrong answer links to a standards-aligned video clip. At the end of the quiz, a scoring function reveals the number of correct initial answers.
Glossary	Check out definitions of key terms and view video clips that reinforce the concepts.
DVD Features	View a quick overview of the features found on the DVD.
Teacher's Guide	Print out or view this comprehensive Teacher's Guide in PDF format.
Internet Link	Link to the Bill Nye area of Disney's Edustation Web site, where you can find links to Internet sites related to the content of each Bill Nye program.

From the Bonus Materials menu, you can:

Feature	Description
Bonus Material	Find out what *wasn't* in the episode! In most cases, there's more of the Way Cool Scientist interview, Bill Nye outtakes, and an extra discussion starter.
Additional Clips	See trailers of related DVDs and videos.
Screen-Saver	Download this cool screen-saver for your computer.

The Planning Process

This Guide provides a Lesson Planning Worksheet (see page 12), which can assist you in setting up your instruction around a topic. The following sections of this Implementation Guide are offered to assist your planning process:

- **Determining Objectives and Linking to Standards**
- **The Learning Cycle**
  - **Explore**
  - **Apply**
  - **Extend**
  - **Assess**

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Determining Objectives and Linking to Standards

1. The NSES Teaching Standard A states that science teachers must "select science content and adapt and design curricula to meet the interest, knowledge, understanding, abilities, and experience of students."

   The NSES recommends that teachers "integrate . . . a practical structure for the sequence of activities, and the content to be learned." The primary instructional model recommended by the NSES is inquiry into authentic student-generated questions about natural or designed phenomena. Since most state and local standards documents were derived from the NSES, you will find that your local and state standards match closely with content standards in the Bill Nye DVD.

   Each DVD contains a menu of clips that are aligned with the NSES. You can review the standards and their aligned clips in the Science Standards menu under Watch Program. Also, the Standards listed on page 10 of this Guide allow you to look at additional NSES content standards that are addressed on the video. Here's an example of the content standards and clips aligned with the Bill Nye DVD entitled *Blood and Circulation*:

Life Science Standards (NSES) Addressed in *Blood and Circulation*

Life Science:
Structure and function in living systems

- **Living systems at all levels of organization demonstrate the complementary nature of structure and function.**

  Aligned clips:

  - **1 Blood vessels**
  - **2 Heart pump and bloodstream**
  - **3 Heart valves and blood circulation**
  - **4 White blood cells**
  - **5 Capillaries**

- **The human organism has systems for digestion, respiration, reproduction, circulation, excretion, movement, control, and coordination, and for protection.**

  Aligned clips:

  - **6 Heart pump**
  - **7 Heart muscle**
  - **8 Pumping blood to brain**

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2. Determine your objectives for the lesson and how these objectives address the standards.

Sample Objectives for *Blood and Circulation*

In this activity students will:

- **Observe and describe a body system responsible for supply and transport.**
- **Use this information to define a body system.**
- **Ask questions about the circulatory system.**
- **Explain how structure complements function in organs of the circulatory system.**
- **Cite examples of current research related to this system.**

3. Design a learning cycle of instructional experiences and assessments for the students to engage in that will help students meet these standards. Students may be given teacher-planned investigations or may be guided to design their own investigations.

The Learning Cycle

The learning cycle is a sequence of activities that involve students in the learning process. The sequence found here is based on research from Lawson**,** Abraham, and Renner published in 1989. That has been adapted to include: Explore, Apply, Extend and Assess:

Explore: Involves assessing students' prior knowledge and providing opportunities for students to interact with content from the video.

Apply: Includes having students use the content learned during the Explore section in a new way that is meaningful to future learning.

Extend: Allows students to conduct further research around an area of interest within the topic.

Assess: Provides strategies meant to inform students and teachers about the content and processes that have been learned.

Explore

The NSES Teaching Standard B states: "Teachers of science guide and facilitate learning." This standard addresses the constant need to balance your predetermined goals with allowing students to set and meet their own learning goals.

Focus and Support Inquiries: Support student inquiries by making decisions about "when to provide information" and "when to connect students with other sources." Knowing the best time to intervene is often determined by allowing students to ask questions and to explore concepts openly.

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The NSES Teaching Standard C states: "Teachers of science engage in ongoing assessment of their teaching and of student learning."

Assess in Order to Guide Teaching: The Program Overview or the Discussion Starter on the DVD can be used to gauge students' prior knowledge. You can use student responses to make decisions about appropriate instruction and adaptations in order to meet the needs of individual students. Assessment can be in the form of student reflections from standards-aligned video clips or answers to questions found on the science quiz. Or, as in the following example, a simple graphic organizer can facilitate a formative assessment.

Example: T-Chart from *Blood and Circulation*

1. Ask students to fill out the "Know-New" T-Chart (see page 14). Have them list what they already know about the circulatory system (heart, blood vessels, blood, etc.) on the left side of their charts.

2. Show the Program Overview for *Blood and Circulation*. On the right side of the chart, have students list new things they have learned from watching the clip. Walk around the room and assist students in filling in their T-Charts. Replay the program as necessary to allow students to review sections of interest.

3. Once students have completed their charts, ask them to share what they have listed in the "New" column. Write these on the board. Have students write their own working definitions of the circulatory system. Once students have completed their definitions, collect and review their work to assess prior knowledge.

Conduct direct vocabulary instruction in the Explore phase. Research suggests that:

- Students must encounter words in context more than once to learn them.
- Instruction in new words enhances learning those words in context.
- One of the best ways to learn a new word is to associate an image with it.
- Direct vocabulary instruction on words that are critical to new content produces the most powerful learning.

Use the DVD Glossary with the linked video clips to expose students to new vocabulary words in context, along with associated video images. You can also find a printed version of the glossary terms in this Guide on page 16.

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Example: Using the Glossary for Direct Vocabulary Instruction
Blood and Circulation

1. Present students with a brief explanation or description of the new term or phrase from the glossary. For example: “Capillary: A small blood vessel that connects arteries and veins.”
2. Present students with a nonlinguistic representation of the new term or phrase. Show the video clip associated with the term “capillary.”
3. Ask students to generate their own verbal description of “capillary.”
4. Ask students to create their own nonlinguistic representation of “capillary.”
5. Periodically ask students to review the accuracy of their explanations and representations. This can be done after the Apply activities.

Apply

Based on the information you gained from the Explore assessments, design appropriate activities for your students. Check the experiments listed in the Episode Guide (see page 11) for explanations of the demonstrations from the Bill Nye program as well as for additional experiments designed to help apply the knowledge gained.

In the following example from *Blood and Circulation*, the standards-based video clips provide background information, and an experiment from the Guide helps students apply what they have learned about arteries and veins.

Example: The Structure and Function of Arteries and Veins

1. Have students begin “Know-New” T-Charts, focusing on what they already know about the structure and function of blood vessels, arteries, and veins.
2. Watch the following chapters from the Bill Nye DVD *Blood and Circulation*:
   - Blood vessels
   - Heart pump and bloodstream
   - Capillaries
3. Complete the “Know-New” T-Charts.
4. Give students copies of the Student Recording Sheet (see page 15) and have them fill the sheets out as they conduct their experiments.
5. Do the experiment entitled “Pump it Up!” from the *Blood and Circulation* Episode Guide, in which students observe the apparent effects of pressure on arteries and veins.
6. Write down any remaining questions about the structure and function of blood vessels, arteries, and veins.

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Extend

The NSES Teaching Standard D states: "Teachers of science design and manage learning environments that provide students with the time, space, and resources needed for learning science." School administrators, parents, and the community can assist teachers in providing local resources that make science lessons pertinent and meaningful.

Identify and Use Resources Outside of the School: "The school science program must extend beyond the walls of the school." Each Bill Nye DVD contains resources designed to facilitate such understanding, including:

- Way Cool Scientist, found in both Watch Program and Bonus Materials, in which scientists discuss their current areas of study. This real-world connection often results in a deeper student understanding of a particular career.
- Disney's Edustation Web site, where relevant Internet links provide a starting point for students to further explore science topics.
- Try these video clips, with activities parents and students can do at home. The questions generated by students from these experiences can be used as foundations from which they may conduct their own research.
- Standards-aligned video clips and Bill's demonstration video clips, which can help generate topics for further research. After viewing the clips, have students list their questions, perhaps about the most current developments in a topic. By conducting online or library research, students will find answers to their questions and will learn about a topic in greater depth.

Example: Conducting Student Research Using *Blood and Circulation*

Ask students to choose one of the questions they had after completing the activities from *Blood and Circulation*. An example of a student research question might be, "How has the technology related to artificial hearts advanced in the last ten years?" Explain to students that they will be conducting research to find answers to their questions. Some students may want to complete online or library research, others may want to ask an expert in the field, while others may want to design and conduct a scientific investigation. Encourage students to write a detailed procedure for finding answers to their questions. Ask students to find one or more examples of current research dealing with the circulatory system that is related to their question. NOTE: Students with similar questions may work together to complete the assignment.

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Assess

Once students have conducted the research, you may choose to assess them in a number of different ways:

- By having students write about what they learned in a journal.
- By having students submit projects or reports.
- By having students take the program quiz to gauge their understanding of certain facts in the video. You can either print the quiz (found in this Guide on page 18) and have each student complete it individually or use the DVD screen version and the scoring feature for whole-class assessment.
- By designing other standards-aligned questions to augment those that are provided.

While the quiz will provide you with information about what the students have learned, it does not assess how students have processed the information. Below you will find assessment ideas that can be used to measure both content and process.

A Sample Assessment for *Blood and Circulation*

1. Explain to students that an important aspect of scientific inquiry is to communicate findings to others. In this assessment, students will present the following information to their peers:
   - The question they investigated.
   - The method that was used to find answers to their question.
   - Problems or successes during the search.
   - Answers to their question.
   - Current research related to their question.
   - New questions that have arisen.
2. Distribute the rubric found in the Lesson Planning Worksheet (see page 13) to students so they know how they will be assessed. Make sure students understand the criteria found in the rubric. Before you begin, you may want to allow students to make changes to the rubric so that it is clearer or makes more sense from their perspectives.
3. Allow students time to gather information to answer their questions and to prepare for their presentations. As students conduct this work, walk around the room and ask questions to assess their progress and provide input as needed.
4. Take a few minutes to clarify the rules of the presentation with the students. You may want to have multiple copies of the rubric available so that peers can rate the presentations.
5. As presentations are made, assess the quality of the student's work as thoroughly and as equitably as you possibly can.

Congratulations! You have now completed the steps to set up a lesson plan using the Lesson Planning Worksheet. You have also explored many of the features of the Bill Nye DVD as well as the supplemental information found in this Teacher's Guide. And most important, you've made significant strides toward incorporating DVD technology into your day-to-day instruction.

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National Science Education Standards

Earthquakes

Standards/Benchmarks – Grades 5-8

Grades K-4

Science as Inquiry

Abilities necessary to do scientific inquiry

- Ask a question about objects, organisms, and events in the environment.
- Employ simple equipment and tools to gather data and extend the senses.
- Use data to construct a reasonable explanation.
- Communicate investigations and explanations.

Understandings about scientific inquiry

- Scientists use different kinds of investigations depending on the questions they are trying to answer. Types of investigations include describing objects, events, and organisms; classifying them; and doing a fair test (experimenting).
- Simple instruments, such as magnifiers, thermometers, and rulers, provide more information than scientists obtain using only their senses.
- Scientists develop explanations using observations (evidence) and what they already know about the world (scientific knowledge). Good explanations are based on evidence from investigations.

Earth and Space Science

Properties of earth materials

- Earth materials are solid rocks and soils, water, and the gases of the atmosphere. The varied materials have different physical and chemical properties, which make them useful in different ways, for example, as building materials, as sources of fuel, or for growing the plants we use as food. Earth materials provide many of the resources that humans use.

Changes in the earth and sky

- The surface of the earth changes. Some changes are due to slow processes, such as erosion and weathering, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes.

Science in Personal and Social Perspectives

Science and technology in local challenges

- Science and technology have greatly improved food quality and quantity, transportation, health, sanitation, and communication. These benefits of science and technology are not available to all of the people in the world.

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Grades 5-8

Science as Inquiry

Abilities necessary to do scientific inquiry

- Develop descriptions, explanations, predictions, and models using evidence.

Understandings about scientific inquiry

- Different kinds of questions suggest different kinds of scientific investigations. Some investigations involve observing and describing objects, organisms, or events; some involve collecting specimens; some involve experiments; some involve seeking more information; some involve discovery of new objects and phenomena; and some involve making models.
- Technology used to gather data enhances accuracy and allows scientists to analyze and quantify results of investigations.

Earth and Space Science

Structure of the earth system

- The solid earth is layered with a lithosphere; hot, convecting mantle; and dense, metallic core.
- Lithospheric plates on the scales of continents and oceans constantly move at rates of centimeters per year in response to movements in the mantle. Major geological events, such as earthquakes, volcanic eruptions, and mountain building, result from these plate motions.
- Land forms are the result of a combination of constructive and destructive forces. Constructive forces include crustal deformation, volcanic eruption, and deposition of sediment, while destructive forces include weathering and erosion.

Science in Personal and Social Perspectives

Natural hazards

- Internal and external processes of the earth system cause natural hazards, events that change or destroy human and wildlife habitats, damage property, and harm or kill humans. Natural hazards include earthquakes, landslides, wildfires, volcanic eruptions, floods, storms, and even possible impacts of asteroids.

Risks and benefits

- Students should understand the risks associated with natural hazards (fires, floods, tornadoes, hurricanes, earthquakes, and volcanic eruptions), with chemical hazards (pollutants in air, water, soil, and food), with biological hazards (pollen, viruses, bacterial, and parasites), social hazards (occupational safety and transportation), and with personal hazards (smoking, dieting, and drinking).
- Important personal and social decisions are made based on perceptions of benefits and risks.

History and Nature of Science

Nature of science

- Scientists formulate and test their explanations of nature using observation, experiments, and theoretical and mathematical models. Although all scientific ideas are tentative and subject to change and improvement in principle, for most major ideas in science, there is much experimental and observational confirmation. Those ideas are not likely to change greatly in the future. Scientists do and have changed their ideas about nature when they encounter new experimental evidence that does not match their existing explanations.

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Episode Guide

Earthquakes

Nifty Questions in This Episode	Awesome Answers
What causes earthquakes?	Large pieces of the Earth's crust (plates) move a little.
What does the Earth's surface rest on?	The Earth's surface floats on thick molten rock.
What are faults?	Cracks in the Earth that store energy (like a spring); when released, this energy causes the Earth to move.

Experiments shown on the video:

MAKE A QUAKE

Objective: To demonstrate forces of an earthquake.

- Cut shoe box in half.
- Slide box back together with cut sides overlapping each other.
- Fill with sand and pat down.
- Push ends of box together, then apart.
- Observe land movement with simulated earthquake.

MAKE YOUR OWN SEISMOMETER

Objective: To demonstrate that an object falls toward the force applied.

- Take eraser off the end of a pencil, and stick the other end in small ball of clay.
- Place on tabletop; place about 10 plastic bottle caps around ball of clay.
- Place a marble on top of the pencil. Now, hit the side of the table to simulate a quake.
- Note that the marble falls toward the direction the quake came from.

More interesting stuff to do:

QUAKING ARCHES

Objective: To show how the Earth's crust moves when its plates are moved.

- Place a 3" x 5" or 4" x 6" index card between two blocks of wood or other small weighted objects. Push blocks together, pushing card up to form a high arch of the index card (lift card with finger to aid in forming arch) and leave in this position.
- Repeat this procedure, making 10 or more arches.
- Place rulers or yard/meter sticks across the tops of two or more arches.
- Push together or pull apart blocks of wood to form different heights of arches.
- Observe angle and various levels of rulers.
- Repeat, using string or yarn instead of rulers/sticks. Notice how the plates and surface move when energy is applied.

BOXED-UP WAVES

Objective: To demonstrate how the structure of the Earth affects earthquake waves.

- Use a shoebox with a lid or a box of your design with similar dimensions.
- Cut a 3-1/2" lengthwise piece from the side of the box (side facing you).
- Insulate all sides, including top, of the inside of the box with styrofoam or other material to dampen sound from within box.
- Place a 600-ml beaker or glass into the 3-1/2" opening; tape around beaker and opening.
- Place a portable battery-operated radio inside box and turn on to medium volume.
- Fill the beaker at different times with these substances in the following order: air, sand/dirt; pebbles, rocks, water, vegetable oil, syrup. Cover box with lid and place your ear against the beaker as you test each one.
- Adjust volume, depending upon area reception; the lower, the better for consistent results. Record in order the substance that produces the clearest, loudest, and most sound vibrations.

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Lesson Planning Worksheet

Lesson Title _____

Objectives _____

_____

_____

Estimated Time Required _____

Materials Needed _____

_____

National Science Educational Standards

_____

_____

_____

_____

_____

Explore _____

_____

_____

_____

Apply _____

_____

_____

_____

Extend _____

_____

_____

_____

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Assess

As presentations are made, assess the quality of the student's work as thoroughly and as equitably as you possibly can. The following criteria can be used to assist in your assessment.

Name of Student _____

Question Investigated _____

Initial Question			
1 Question is broad and not well defined	2 Question is defined but limited to single-answer responses.	3 Question is clear and might elicit multiple responses that may lead to new ideas and additional questions.	4 Question is engaging and provokes new ways of thinking about an issue.
Methods for Finding Answers			
1 Students do not share planned or actual methods.	2 Students share methods but they are unclear or vague.	3 Students share methods but not the problems or successes of using the methods.	4 Students share methods and problems or successes in using the methods.
Results			
1 Student results are undefined.	2 Student results are incomplete and do not adequately answer the question.	3 Student results are complete, adequately answer the question, and include current research related to the question.	4 Student results are complete, include current research, and have resulted in one or more additional questions.
Communication			
1 Student is not prepared to speak.	2 Presenter has distracting mannerisms and avoids eye contact with the audience.	3 Presentation is clean and clear with some eye contact and very few distractions.	4 Presentation is exceptional and unique. Presenter uses regular eye contact and avoids distractions.

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Student "Know / New" Chart

Know	New
Write down what you know about the topic of the video.	Write down information from the video that is new to you.

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Student Recording Sheet

Name _____ Date _____

Title of Experiment _____

Question: (What are you testing?) _____

Procedure: (Describe the experiment) _____

Materials: (List what you used) _____

Observations: (Record what happened) _____

Results: (Make your own data table)

Conclusions: (Use your observations and results to describe what you learned)

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Glossary

Earthquakes

Fold and cut to use as flashcards.

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TECTONIC PLATES

Tectonic Plates

Earth's outer layer is broken up into large tectonic plates of rock that float slowly over molten (melted) rock.

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FAULT (FAULT LINE)

Fault (fault line)

A fault line is a crack or fracture in the Earth's crust along which movement, dislocation and overlaps of plates occur.

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SEISMOMETER

Seismometer

A seismometer is an instrument that can detect and measure movement in the Earth's surface.

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SEISMOGRAPH

Seismograph

A seismograph is a device that records seismic (earthquake) waves. With this technology, scientists can determine the location, strength, and direction of an earthquake.

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LAVA

Lava

Lava is molten (melted) rock or magma from the Earth's interior that surfaces through a volcano or crack in the Earth's crust.

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EPICENTER

Epicenter

The epicenter is the center of an earthquake, the point on the Earth's surface directly above where an earthquake started.

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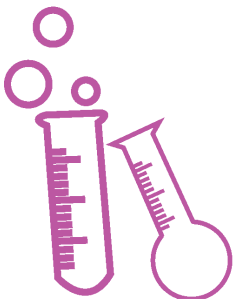
RICHTER SCALE

Richter scale

Named for the creator Charles F. Richter, this scale of 1 to 10 is used to express the magnitude or strength of an earthquake and provides a way of comparing the size of one earthquake to another.



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Name _____ Date _____

Quiz

Earthquakes

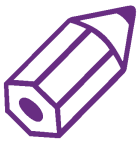
True or False? Circle T or F

1. Earthquakes occur only once or twice a year. T or F
2. The Earth's surface is very rigid. T or F
3. Earth's surface floats on molten rock. T or F
4. Tectonic plates are very small. T or F
5. Oceans float on tectonic plates. T or F
6. Volcanoes and mountains are formed when tectonic plates are moving apart. T or F
7. In most earthquakes, faults are vertical. T or F

Multiple Choice: Circle the letter of the best answer

8. Which of the following describes the direction in which the Earth's plates can move?
   - A. They can move to the right.
   - B. They can move to the left.
   - C. They can move up and down.
   - D. All of the above

9. Which of the following conditions is involved in producing earthquakes?
   - A. Plate movement forms faults.
   - B. Faults store energy.
   - C. Plates release energy as they slide against each other.
   - D. All of the above



10. If Earthquake X measured 1 and Earthquake Y measured 3 on the Richter scale, then
    - A. Earthquake Y had three times the ground motion of Earthquake X.
    - B. Earthquake Y had ten times the ground motion of Earthquake X.
    - C. Earthquake Y had 100 times the ground motion of Earthquake X.
    - D. None of the above

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Answer Key

Earthquakes

1. F
2. F
3. T
4. F
5. T
6. F
7. T
8. D
9. D
10. C

TECTONIC PLATES

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